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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

Water, sediment and plankton from the Chesapeake Bay were analysed for total mercury using flameless atomic absorption techniques. The concentrations of mercury in the sediment ranged from 0.80 to 0.02 ppm, from 4.9 ± 0.10 ppm to 0.02 ± 0.01 ppm in plankton and 0.00 ppb to 0.49 ppb in the water. Petroleum fractions from the sediment were found to contain 0.1% of mercury by weight. Elemental sulfur was found in concentrations as high as 1% of the sediment (dry wt.)

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MERCURY DISTRIBUTION IN THE CHESAPEAKE BAY

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As part of the National Bureau of Standards program[1] on heavy metals pollution, the distribution of mercury in the Chesapeake Bay is being surveyed in collaboration with Dr. Rita Colwell's group at the University of Maryland and others.

Water, plankton, and sediment samples were taken at a number of Chesapeake Bay sites which were selected for their accessibility, exposure to technological effluents and availability of biological data. Sediment samples (grab and gravity cores) were frozen to −80°C as soon as they were obtained.

The samples were analyzed for total mercury using flameless atomic absorption techniques (EPA Provisional Method for Mercury in Sediment and Water, January 1972). The values obtained were determined from standard curves constructed by least square fits. Redox potential, pH, and total sulfide ion activity measurements were made at 10 cm depth intervals, on portions of the fresh core samples, alternate to those portions removed and frozen for mercury analysis. Most of the data on the core samples is in the process of evaluation, and the mercury, as well as other heavy metal, concentrations in frozen core samples from the entire Chesapeake Bay still await determination. The results of a preliminary survey of the sediments from the upper portion of the Bay are shown in Table 1.

The concentrations vary from 0.80 ppm, at Colgate Creek near Baltimore, a heavily polluted area, to 0.02 ppm in the middle of the ship channel below Annapolis. Total mercury concentration in plankton (zoo- and phyto-) ranged from 4.9 ± 0.10 ppm to 0.02 ± 0.01 ppm with an average of 0.92 ppm for 15 stations. The total mercury concentration in unfiltered water from 17 stations ranged from 0.00 ppb to 0.49 ppb with an average of 0.24 ppb.

The table illustrates the relationship between the concentrations of total mercury in the sediment, water, and plankton at all stations. As is evident, there is almost a five-thousandfold increase in mercury concentration from the water to the plankton which is in accordance with the findings of others.[2]

No attempts have been made to speciate the mercury in water, plankton, or sediment samples other than the direct field detection of a very small quantities (1–2 ng) of mercury vapor from sediments. In addition to the marked involvement of plankton as a (at least intermediate) "sink" in the transport of mercury through estuarine media, a more recent finding suggests that another "sink" may be significant. Dr. John Walker (Colwell's group) has found mercury to be of significance in petroleum fractions isolated from the sediment in a highly polluted area (Colgate Creek).[3] In association with Dr. Walker, we have found total mercury concentrations approaching 0.1% by weight in some cases which suggests a preferred solvation of certain mercury-containing compounds from the aqueous phase. Preliminary chromatographic analysis indicates the mercury to be eluted along with the C_{16}–C_{18} fragments in the petroleum fractions rather than appearing as free metal or simple methylmercurial species.[4]

To make the situation more complex, we have found elemental sulfur to be present in these same petroleum enriched fractions in concentrations as high as 1% of the sediment (dry weight). A possible mercury trapping mechanism is suggested involving selective partitioning of mercury into the petroleum residues and its subsequent inactivation by sulfur.

†NBS Guest Worker, 1973.

TABLE 1
Distribution of total mercury concentration[a] at selected stations in the Chesapeake Bay

Station	Position	Sediment[b]	Water[c]	Plankton[d]	Plankton/water
Colgate Cr.	N 39° 15′ 15″	0.90 ± 0.03	0.20 ± 0.01	—	—
	W 76° 36′ 15″	0.67 ± 0.01	—	0.09 ± 0.01	—
		0.65 ± 0.02	0.04 ± 0.02	0.17 ± 0.02	4250
		—	—	0.23 ± 0.00	—
Baltimore	N 39° 11′ 30″	1.12 ± 0.43	0.02 ± 0.01	1.53 ± 0.12	7650
Harbor 7B	W 76° 28′ 54″	0.26 ± 0.01	0.37 ± 0.01	1.65 ± 0.19	4460
		0.25 ± 0.01	0.24 ± 0.01	0.35 ± 0.04	1460
Parson's Is.	N 38° 54′ 05″	0.19 ± 0.00	0.68 ± 0.11	0.39 ± 0.03	570
	W 76° 13′ 35″	0.04 ± 0.01	0.33 ± 0.01	1.20 ± 0.10	3640
		0.09 ± 0.01	0.26 ± 0.01	0.15 ± 0.02	580
		0.04 ± 0.00	0.10 ± 0.02	0.06	600
Sandy Pt. Lt.	N 39° 00′ 00″	0.00 ± 0.00	0.28 ± 0.05	1.07 ± 0.53	3820
No. 900	W 76° 23′ 00″	0.13 ± 0.00	0.08 ± 0.01	0.18	2250
Matapeake	N 38° 57′ 43″	0.20 ± 0.08	0.04 ± 0.01	—	—
No. 858-C	W 76° 22′ 49″	0.20 ± 0.03	—	0.20 ± 0.00	—

[a] All analyses performed in accord with Environmental Protection Provisional Methods (January 1972). Results are cited ± average deviation for three or more duplicate runs.
[b] In ppm or μg/g dry weight.
[c] Unfiltered samples; in ppb or μg/l.
[d] Lyophilized samples; in ppm or μg/g dry weight.

The petroleum may, conversely, be an excellent reservoir for mercury contamination since many of the same microorganisms which transform sediment-bound mercury can also degrade the metallized petroleum with possible re-release of mercury. Whether or not the sulfur cycle is ultimately involved in "freezing" mercury to the marine sediment is not yet known, and experiments are underway to clarify this aspect.

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